



A.D. 1858, 4th MARCH. N° 437.

**Apparatus for Applying and Measuring Resistance to
the Motion of Rotating Wheels, Shafts, &c.**

LETTERS PATENT to William Thomson, Doctor of Laws, Professor of Natural Philosophy in the University and College of Glasgow, in the County of Lanark, for the Invention of "**IMPROVEMENTS IN APPARATUS FOR APPLYING AND MEASURING RESISTANCE TO THE MOTION OF ROTATING WHEELS, SHAFTS, OR OTHER ROTATING BODIES.**"

Sealed the 30th April 1858, and dated the 4th March 1858.

PROVISIONAL SPECIFICATION left by the said William Thomson at the Office of the Commissioners of Patents, with his Petition, on the 4th March 1858.

I, WILLIAM THOMSON, Doctor of Laws, Professor of Natural Philosophy in
5 the University and College of Glasgow, do hereby declare the nature of the
said Invention for "**IMPROVEMENTS IN APPARATUS FOR APPLYING AND MEASURING
RESISTANCE TO THE MOTION OF ROTATING WHEELS, SHAFTS, OR OTHER ROTATING
BODIES,**" to be as follows, and for the sake of distinctness I have divided the
description of the nature of the said Invention into several parts, that is
10 to say:—

Part First. A chain, strap, cord, wire, rope, or other jointed or continuous
or more or less flexible chain or band, with its surface protected or unprotected,
is wrapt round any part of the circumference of a rotating wheel, shaft, or other
rotating body, or round the whole circumference, or more than once round, and
15 is held by a regulated force applied longitudinally in a direction opposed to
the motion of the rotating body, at one end or part of its length, while the

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other end or another part of it is either attached to a fixed body or to a spring balance or other piece of apparatus, adapted to indicate the force with which it is drawn. I make this arrangement, that is to say, I apply the regulated force at the end or part of the chain or band where the tension is greatest, and I leave the tension at the end or part where it is least to vary with the 5 variations of friction, because when the regulated force is so applied, the resistance cannot exceed the amount of such regulated force, whereas, if it were applied at the end or part where the tension is least, the resistance might increase to an amount exceeding that regulated force in an uncertain proportion, and thereby might produce irregular motion or sudden stoppage of 10 the rotating body.

Part Second. A chain or band, as specified in part first, is wrapt round the whole or any portions of the circumferences of a number of different drums or pulleys or other rotating bodies having motions round parallel axes geared together or not, or it is wrapped more than once round any one or more than 15 one of these drums or pulleys. One end or part of it is urged by a longitudinal force as described in part first, and the other end or another part as also described in part first is held fixed or is attached to a spring balance or other apparatus for indicating tension. I make this arrangement to the effect that when the different drums or pulleys are in motion, their motions 20 shall be each resisted to a degree which may be modified by regulating the forces applied at the two ends of the chain or band, or more especially by regulating the force applied at the end or part where the tension is greatest, leaving that where it is least to vary according to the varying frictions.

Part Third. I propose to apply the arrangements described above to resist 25 and regulate the motion of the drum or drums, or pulley or pulleys, or to the system of grooved pulleys or sheaves or drums used in laying submarine cables, and I propose to use suitable means of indicating the amount of resistance so applied, or the whole resistance opposed to the egress of the cable. When the operation will occupy so much time as to render it desirable 30 to renew any part of the rubbing surfaces or bodies without stopping the motion, I propose to use a chain or band of greater length than is requisite merely for carrying out the arrangement for applying the resistance as before described, and I propose to draw that chain or band gradually, or to let it run gradually over the drum or drums, pulley or pulleys, so that fresh parts of it 35 may successively be exposed to the friction, and to change, when convenient, the places upon it, where the longitudinal forces are applied as stated above; also to shift the chain or band to different parts of the surface or surfaces rubbed by it, and to renew these surfaces by the application of suitable

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protecting materials ; also to use different chains or bands and different rubbing surfaces in succession or by turns.

Part Fourth. I propose to use the arrangement which has been described for the purpose of testing the action of water wheels, steam engines, and other
5 prime movers.

SPECIFICATION in pursuance of the conditions of the Letters Patent, filed by the said William Thomson in the Great Seal Patent Office on the 2nd September 1858.

TO ALL TO WHOM THESE PRESENTS SHALL COME, I, WILLIAM
10 **THOMSON**, Doctor of Laws, Professor of Natural Philosophy, in the University and College of Glasgow, in the County of Lanark, send greeting.

WHEREAS Her most Excellent Majesty Queen Victoria, by Her Letters Patent, bearing date the Fourth day of March, in the year of our Lord Eighteen hundred and fifty-eight, in the twenty-first year of Her reign, did,
15 for Herself, Her heirs and successors, give and grant unto me, the said William Thomson, Her special license that I, the said William Thomson, my executors, administrators, and assigns, or such others as I, the said William Thomson, my executors, administrators, and assigns, should at any time agree with, and no others, from time to time and at all times thereafter
20 during the term therein expressed, should and lawfully might make, use, exercise, and vend, within the United Kingdom of Great Britain and Ireland, the Channel Islands, and Isle of Man, an Invention for "**IMPROVEMENTS IN APPARATUS FOR APPLYING AND MEASURING RESISTANCE TO THE MOTION OF ROTATING WHEELS, SHAFTS, OR OTHER ROTATING BODIES,**" upon the condition
25 (amongst others) that I, the said William Thomson, by an instrument in writing under my hand and seal, should particularly describe and ascertain the nature of the said Invention, and in what manner the same was to be performed, and cause the same to be filed in the Great Seal Patent Office within six calendar months next and immediately after the date of the
30 said Letters Patent.

NOW KNOW YE, that I, the said William Thomson, do hereby declare the nature of my said Invention, and in what manner the same is to be performed, to be particularly described and ascertained in and by the following statement thereof, that is to say:—

35 For the sake of distinctness I have divided the description of the said Invention into several parts, viz^t:—

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Part First. A chain, strap, cord, wire, rope, or other jointed or continuous or more or less flexible chain or band, with its surface protected or unprotected, is wrapt round any part of the circumference of a rotating wheel, shaft, or other rotating body, or round the whole circumference, or more than once round, and is held by a regulated force applied longitudinally in a direction 5 opposed to the motion of the rotating body at one end or part of its length, while the other end (of it) or another part of it is either attached to a fixed body or to a spring balance or other piece of apparatus adapted to indicate the force with which it is drawn. The regulated force may be a weight applied directly, or a weight acting through levers or other mechanism, or the 10 elasticity of a spring so adjusted as to exert a constant or nearly constant force, or human strength exerted directly or through mechanism, with an intensity adjusted according to a spring balance or other indicator, or otherwise, or generally such force as can conveniently be regulated to a fixed amount, being that which the resistance is not to exceed. I make this 15 arrangement, that is to say, I apply the regulated force at the end or part of the chain or band where the tension is greatest, and I leave the tension at the end or part where it is least to vary with the variations of friction, because when the regulated force is so applied the resistance cannot exceed the amount of such regulated force ; whereas if it were applied at the end or part 20 where the tension is least, the resistance might increase to an amount exceeding that regulated force in an uncertain proportion, and thereby might produce irregular motion or sudden stoppage of the rotating body, which irregular motion and sudden stoppage are in many cases, such as that of the laying of telegraph cables, inconvenient, detrimental, and dangerous. 25

Part Second. A chain or band, as specified in part first, is wrapped round the whole or any portions of the circumferences of a number of different drums or pulleys or other rotating bodies, having motions round parallel axes geared together or not, or it is wrapped more than once around any one or more than one of these drums or pulleys ; one end or part of it is urged by a 30 longitudinal force, as described in part first, and the other end or another part, as also described in part first, is held fixed or is attached to a spring balance or other apparatus for indicating tension. I make this arrangement to the effect that when the different drums or pulleys are in motion, their motions shall be each resisted to a degree which may be modified by regulating 35 the forces applied at the two ends of the chain or band, or more especially by regulating the force applied at the end or part where the tension is greatest, leaving that where it is least to vary according to the varying frictions.

Part Third. I apply the arrangements described above to resist and regulate

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the motion of the drum or drums or pulley or pulleys, or to the system of grooved pulleys or sheaves, or drums used in laying submarine cables, and I use suitable means for indicating the amount of resistance so applied, or the whole resistance opposed to the egress of the cable. When the operation
5 occupies so much time as to render it desirable to renew any part of the rubbing surfaces or bodies without stopping the motion, I use a chain or band of greater length than is requisite merely for carrying out the arrangement for applying the resistance, as before described, and I draw that chain or band gradually or let it run gradually over the drum or drums, pulley or pulleys, so
10 that fresh parts of it are successively exposed to the friction, and I change when convenient the places upon it where the longitudinal forces are applied, as stated above. I also shift the chain or band to different parts of the surface or surfaces rubbed by it, and I renew these surfaces by the application of suitable protecting materials. I also use different chains or bands and different
15 rubbing surfaces in succession or by turns.

Part Fourth. I use the arrangement which has been described for the purpose of testing the action of water wheels, steam engines, and other prime movers. In performing this part of my Invention I employ the prime mover to drive a rotating body resisted by the friction of a band, which is held at the
20 end or part where the tension is greatest by a regulated force, and at the end or part where the tension is least by a spring balance or other indicator of force. The difference between the regulated force and the force indicated by the spring balance or otherwise, is the resistance overcome at the rubbing surface of the rotating body, which, being multiplied by the velocity of that
25 surface, gives the work performed in a given time.

In performing all the parts of my Invention herein-before described, I sometimes attach the frictional band at various points of its length to fixed points by means of springs, so adjusted that when no tension is applied to the band by the regulated force it is drawn out of contact with the rotating body
30 or bodies. The object of this is to prevent, if necessary, any adhesion between the band and the rotating body or bodies from taking effect when the tension is removed.

I do not claim the application of frictional chains and bands in general for resisting the motion of rotating bodies, for such application is ordinary and
35 well known, when the regulated force or tension which causes the friction is applied to that end or part of the chain or band where the tension is least, or by a lever or connecting arm attached to each end of the said chain or band; but what I do claim is,—

First, the applying of the regulated force to a frictional chain or band of

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any kind for resisting the motion of a rotating body at that end or part of the chain or band where its tension is greatest, so as to prevent the possibility of the resistance becoming greater than that regulated force.

Secondly, the applying the regulated force in the same manner when one frictional chain or band resists the motion of two or more rotating bodies. 5

Thirdly, the using of the arrangements herein-before claimed for applying and measuring resistance to the motion of machinery for laying submarine cables.

Fourthly, the renewing the rubbing surface of the chain or band in the before mentioned arrangements by causing it to move longitudinally. 10

Fifthly, the application of these arrangements to the measurement of motive power, as herein-before described under the head of the fourth part of my Invention.

In witness whereof, I, the said William Thomson, have hereto set my hand and seal, this Thirty-first day of August, in the year of our Lord 15
Eighteen hundred and fifty-eight.

WILLIAM THOMSON. (L.S.)

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Printers to the Queen's most Excellent Majesty. 1858.